REMARKS

The Official Action dated December 28, 2004 has been carefully considered. Accordingly, the changes presented herewith, taken with the following remarks, are believed sufficient to place the present application in condition for allowance. Reconsideration is respectfully requested.

In the present amendment, claims 13 and 20 have been cancelled, claims 1, 3, 14, and 19 have been amended and claim 21 has been added. Support for the amendments may be found in original claim 3. Since these changes do not involve any introduction of new matter, entry is believed to be in order and is respectfully requested.

Claims 1-15 were rejected under 35 U.S.C. § 101 as being directed to non-statutory matter. The Examiner asserted that claims 1-15 set forth a system that is not computer dependent since all of the claimed features may be implemented by way of a manual tuning technique, a technique the applicant readily discloses as being known at the time the invention was made. Applicant has amended the claims to clearly recite that claims 1-15 are computer-implemented methods and systems, whereby the rejection under 35 U.S.C. §101 has been overcome. Reconsideration is respectfully requested.

In the Official Action, the Examiner rejected claims 1-3, 7, 13-14, 17 and 19-20 under 35 U.S.C. § 102(b) as being anticipated by Chaffee (U.S. Patent No. 5,684,375). The Examiner asserted that Chaffee teaches a method and system for auto-tuning a motion control system comprising: determining an initial value of a feed-forward compensation parameter (FFCP), commanding an initial (e.g. first) movement of an actuator according to a test routine, wherein the initial value of the parameter is used in the control of the actuator, determining an error associated with the first movement, determining a potential value of the FFCP, commanding a movement (e.g. second movement) of the actuator according to the test routine, wherein the potential value of the parameter is used in the control of the actuator,

determining an error associated with the second movement, wherein at least two movements are used for making this determination.

However, as will be set forth in detail below, it is submitted that the methods and systems for tuning a feedforward compensation parameter in a motion control system set forth by claims 1-3, 7, 14, 17 and 19 are not anticipated by Chaffee. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As defined by presently amended claim 1, the present invention is directed to a computer-implemented method for automatically tuning a feedforward compensation parameter in a motion control system, the method comprising:

a) determining an initial value of the feedforward compensation parameter;

b) commanding an initial movement of an actuator according to a test motion routine, wherein the initial value of the parameter is used in the control of the actuator;

c) determining error associated with the initial movement;

d) determining a potential value of the feedforward compensation parameter;

e) commanding a movement of the actuator according to the test motion routine, wherein the potential value of the parameter is used in the control of the actuator;

f) determining error associated with the movement commanded in act e);

g) comparing the errors associated with the movements;

h) based on the act of comparing the errors, selecting one of the values as a current best value; and

i) repeating acts d) - h) until the current best value is an optimum value, wherein the act of comparing the errors associated with the movements comprises comparing the errors associated with at least two of the movements,

wherein the feedforward compensation parameter comprises at least one parameter selected from the **group consisting of an acceleration feedforward gain, a Coulomb**

friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.

Chaffee is directed to a method for tuning gains in electronic motion control systems. A motor is commanded through a single, unidirectional motion event for tuning these parameters. The motion event comprises driving the motor at a predetermined tuning torque level until the motor reaches maximum velocity, and then decelerating the motor back to zero at the tuning level torque level. During the motion, feedback signals from the motor are monitored and parameters, such as the electrical current applied to the motor, the velocity of the motor, and the acceleration and deceleration times are recorded. Chaffee discloses that a number of values can be calculated based upon the parameters measured and recorded, such as the effective inertia value J_m, the position feedback error proportional gain $K_{p(pos)}$, the velocity feedback error proportional gain $K_{p(vel)}$, the position feedback error integral gain $K_{i(pos)}$, and the velocity feedback error integral gain $K_{i(vel)}$. However, Chaffee fails to disclose tuning the feedforward gain K_{ff}. In fact, Chaffee explicitly discloses that the feedforward gain can be set either to unity or to zero, depending on whether feedforward is to be applied. (Column 11, lines 46-55),

To anticipate, every element and limitation of the claimed invention must be found in a single prior art reference, arranged as in the claim. *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F3d 1376, 1383, 58 U.S.P.Q.2d 1286, 1291 (Fed. Cir. 2001); *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 927 F.2d 1565, 1576, 18 U.S.P.Q.2d 1001, 1010 (Fed. Cir. 1991). Further, the reference must describe the Applicant's claimed invention sufficiently to place a person of ordinary skill in the field of the invention in possession of it. *Akzo N.V. v. United States Int'l Trade Comm'n*, 808 F.2d 1471, 1479, 1 U.S.P.Q.2d 1241, 1245 (Fed. Cir. 1986), *cert denied*, 482 U.S. 909 (1987); *In re Coker*, 463 F.2d 1344, 1348, 175 U.S.P.Q. 26, 29 (CCPA 1972).

Applicant finds no teaching or disclosure in Chaffee of a method for tuning a feedforward compensation parameter in a motion control system comprising, *inter alia*, the act of: determining an initial value of a feedforward compensation parameter, **wherein the feedforward compensation parameter comprises at least one parameter selected from the group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.**

As defined by presently amended claim 14, the present invention is directed to a computer-implemented motion control system comprising:

a) a position command generator adapted to produce position commands;

b) a feedforward command generator adapted to produce feedforward commands based upon feedforward compensation parameters, wherein one of the feedforward compensation parameters comprises at least one parameter selected from the group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain;

d) a controller adapted to communicate with an actuator, the position command generator, and the feedforward command generator, and adapted to control the motion of the actuator based upon the position commands and the feedforward commands; and

e) a feedforward tuning unit adapted to:

i) determine an initial value of the feedforward compensation parameter;

ii) cause the position command generator to produce position commands according to a test motion routine, wherein the initial value of the feedforward compensation parameter is used in the control of the actuator and the actuator undergoes an initial movement;

iii) determine error associated with the initial movement;

iv) determine a potential value of the feedforward compensation parameter;

v) cause the position command generator to produce position commands according to the test motion routine, wherein the potential value of the feedforward compensation parameter is used in the control of the actuator and the actuator undergoes movement;

vi) determine error associated with the movement wherein the potential value was used in the control of the actuator;

vii) compare the errors associated with the movements;

viii) select one of the values as a current best value based on the comparison; and

ix) repeat actions in iv) - viii) until the current best value is an optimum value, wherein the feedforward tuning unit compares the errors associated with at least two of the movements.

Applicant finds no teaching or disclosure in Chaffee of a computer-implemented motion control system comprising, *inter alia*, a feedforward tuning unit adapted to: i) determine an initial value of the feedforward compensation parameter; **wherein one of the feedforward compensation parameters comprises at least one parameter selected from the group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.**

Chaffee discloses a number of parameters that can be calculated, but Chaffee fails to disclose or suggest wherein one of the feedforward compensation parameters comprises at least one parameter selected from the **group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.**

Among other reasons, as every element and limitation of claims 1-3, 7, 14 and 19, as arranged therein, cannot be found in Chaffee, Chaffee does not anticipate the presently claimed invention. Whereby, the rejection has been overcome and reconsideration is respectfully requested.

In the Official Action, claim 4 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Chaffee in view of obviousness. The Examiner conceded that Chaffee does not disclose determining optimum values for a gain parameter *prior* to determining the optimum value for the time-shift parameter. The Examiner asserted it represents a function

that the discloses system of Chaffee obviously would posses so that the system does not have to tune multiple loops concurrently which can require sufficient computational resources, and this would have been obvious to one of ordinary skill in the art at the time the invention was made.

However, as will be set forth in detail below, it is submitted that the method defined by claim 4 is non-obvious and patentably distinguishable from Chaffee. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

To establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981; 180 U.S.P.Q. 580 (CCPA 1974). Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the possession of the public. *Glaxo Inc. v. Novopharm Ltd.*, 34 U.S.P.Q.2d, 1565 (Fed. Cir. 1995); *In re Payne*, 203 U.S.P.Q. 245 (CCPA 1979). Chaffee fails to satisfy these requirements.

The teachings of Chaffee are discussed above. Chaffee fails to teach or suggest a method for tuning a feedforward compensation parameter in a motion control system, the method comprising, *inter alia*, determining an initial value of a feedforward compensation parameter, **wherein the feedforward compensation parameter comprises at least one parameter selected from the group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.**

It is therefore submitted that the presently claimed methods are nonobvious over and patentably distinguishable from Chaffee, whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

In the Official Action, claims 6 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chaffee in view of Junk (U.S. Patent No. 6,128,541). The Examiner conceded that Chaffee does not teach a test routine to be a sinusoidal waveform for commanding movement of an axis. The Examiner also conceded that Chaffee does not teach the determination of the potential compensation parameters being based on a minimization algorithm. The Examiner asserted that Junk disclose an auto-tuner for use in a process control network wherein a sinusoidal test signal is injected into the system in order to determine the response of the system. The Examiner further asserted that Junk discloses that the compensation parameters (e.g. gain) are determined by using the Nelder-Mead downhill simplex method and simulated annealing. The Examiner asserted it would have been obvious at the time of the invention to have incorporated the teachings of Junk into the system disclosed by Chaffee.

However, as will be set forth in detail below, it is submitted that the methods defined by claims 6 and 9 are non-obvious and patentably distinguishable from Chaffee in view of Junk. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As noted above, to establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka, supra.* Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the possession of the public. *Glaxo Inc. v. Novopharm Ltd., supra*; *In re Payne, supra.* Chaffee in view of Junk fail to satisfy these requirements.

The teachings of Chaffee are discussed above. Junk disclose a device and method that automatically tune a valve controller coupled to a process control loop which generate a plurality of sets of tuning parameters for use by the controller, delivers a test signal, such as a blocked sinusoidal signal, to the controller to force the process control loop through a test

cycle while each of the plurality of sets of tuning parameters are being used by the controller and measure a response of the process control loop during each of the test cycles. The device and method then calculate a performance index for each of the plurality of sets of tuning parameters based on the measured responses and select one of the sets of tuning parameters based on the calculated performance indices. The selected set of tuning parameters is then loaded into the controller for use during normal operation of the process control loop. The deficiencies of Chaffee are not overcome with the combination of Junk. Moreover, Junk alone or in combination with Chaffee, fail to teach or suggest a method for tuning a feedforward compensation parameter in a motion control system, the method comprising, *inter alia*, determining an initial value of a feedforward compensation parameter, **wherein the feedforward compensation parameter comprises at least one parameter selected from the group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.**

It is therefore submitted that the presently claimed methods are nonobvious over and patentably distinguishable from Chaffee in view of Junk, whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

In the Official Action, claims 8 and 11-12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chaffee in view of Patel et al. (U.S. Patent No. 6,631,299). The Examiner conceded that Chaffee does not teach the comparison of errors to involve comparing an average of the root means squared value of each of the errors, not the use of a percentage error. The Examiner asserted that Patel et al. disclose a system and method for self-tuning a control system wherein the mean square error is determined as well as the percentage error for each tuning run or step. The Examiner further asserted it would have been obvious to one of ordinary skill in the art to have incorporated the teachings of Patel et

al. into Chaffee so as to provide a way of tuning the system providing very accurate error determination.

However, as will be set forth in detail below, it is submitted that the methods defined by claims 8 and 11-12 are non-obvious and patentably distinguishable from Chaffee in view of Patel et al. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As noted above, to establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka, supra* Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the possession of the public. *Glaxo Inc. v. Novopharm Ltd., supra*; *In re Payne, supra*. Chaffee in view of Patel et al. fail to satisfy these requirements.

The teachings of Chaffee are discussed above. Patel et al. disclose a tuned run-to-run controlled system that provides tuned run-to-run control of a system. The system includes a controlled system coupled to a tuned run-to-run controller, which contains a feedback controller coupled to a tuner. Tuned run-to-run controller determines a feedback command based on a nominal gain, a maximum gain, a process error, and a tuning gain.

The deficiencies of Chaffee are not overcome with the combination of Patel et al. Moreover, Patel et al. alone or in combination with Chaffee, fail to teach or suggest a method for tuning a feedforward compensation parameter in a motion control system, the method comprising, *inter alia*, determining an initial value of a feedforward compensation parameter, **wherein the feedforward compensation parameter comprises at least one parameter selected from the group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.**

It is therefore submitted that the presently claimed methods are nonobvious over and patentably distinguishable from Chaffee in view of Patel et al., whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

In the Official Action, claims 15 and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chaffee in view of Blevins et al. (U.S. Patent No. 6,445,962). The Examiner conceded that Chaffee fails to disclose the use of a communications protocol (HTTP) for the purpose of sending the tuning software to a remote location through the use of the Internet. The Examiner asserted that Blevins et al. disclose the use of a data communication network using a hypertext transfer communications protocol for the purposes of sending the tuning software to a remote location through the use of the Internet. The Examiner further asserted it would have been obvious to one of ordinary skill in the art to have incorporated the teachings of Blevins et al. into Chaffee so as to provide a way of tuning the system regardless of the geographical location of an operator or technician.

However, as will be set forth in detail below, it is submitted that the systems defined by claims 15 and 16 are non-obvious and patentably distinguishable from Chaffee in view of Blevins et al. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As noted above, to establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka, supra* Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the possession of the public. *Glaxo Inc. v. Novopharm Ltd., supra*; *In re Payne, supra.* Chaffee in view of Blevins et al. fail to satisfy these requirements.

The teachings of Chaffee are discussed above. Blevins et al. disclose an auto-tuner for tuning a control element in a process control network having distributed control functions

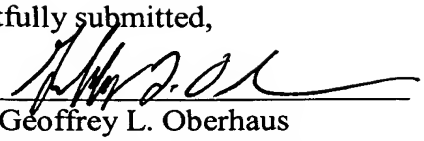
including a first tuning element located in the field device in which the control element is operating and a second tuning element located in a different device that communicates with the first device via a communications network. The deficiencies of Chaffee are not overcome with the combination of Blevins et al. Moreover, Blevins et al. alone or in combination with Chaffee, fail to teach or suggest a motion control system comprising a feedforward tuning unit adapted to: i) determine an initial value of the feedforward compensation parameter; **wherein one of the feedforward compensation parameters comprises at least one parameter selected from the group consisting of an acceleration feedforward gain, a Coulomb friction feedforward gain, a viscous friction feedforward gain and a constant offset feedforward gain.**

It is therefore submitted that the presently claimed systems are nonobvious over and patentably distinguishable from Chaffee in view of Blevins et al., whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

Finally, Applicant appreciates the Examiner's indication of allowable subject matter in claim 18. Newly added claim 21 incorporates the limitations of claim 18 and of the base claim and any intervening claims.

It is believed that the above represents a complete response to the Examiner's objections and rejections under 35 U.S.C. §§101, 102, 103 and places the present application in condition for allowance. Reconsideration and an early allowance are requested.

Respectfully submitted,

By 

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